HAWAII AGRICULTURAL EXPERIMENT STATION.
J. G. SMITH, SPECIAL AGENT IN CHARGE.
BULLETIN No. 3.

Insecticides for Use in Hawaii

BY

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UNDER THE SUPERVISION OF
OFFICE OF EXPERIMENT STATIONS,
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HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU.

[Under the supervision of A. C. True, Director of the Office of Experiment Stations, United States Department of Agriculture.]

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LETTER OF TRANSMITTAL.

HONOLULU, HAWAII, *August 22, 1902.*

DEAR SIR: I have the honor to transmit herewith for publication as Bulletin No. 3 of this station a paper entitled Insecticides for use in Hawaii, prepared under my direction by Mr. D. L. Van Dine, entomologist.

Very respectfully, JARED G. SMITH,
Special Agent in Charge of the Hawaii Agricultural Experiment Station.

DR. A. C. TRUE,
Director Office of Experiment Stations,
U. S. Department of Agriculture, Washington, D. C.

Recommended for publication.

A. C. TRUE,
Director.

Publication authorized.

JAMES WILSON,
Secretary of Agriculture.

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INTRODUCTION.

One of the greatest hindrances to agriculture in these Islands is the ravages of insect pests. The songs of the ancient Hawaiians often refer to the roses once grown, but the roses exist today only in song and in the memory of Kamaainas. Their growing was abandoned because of the destructive work of the Japanese "rose" beetle (*Adoretus umbrosus*).

Watermelons and muskmelons are a luxury, a good watermelon bringing fifty cents to one dollar at the fruit stands in Honolulu. These products could be raised in certain sections, in quantities great enough to bring them within the reach of every table, were it not for the attack of the "melon-fly" (*Dacus cucurbitæ*).

Some sections, otherwise ideal for farming, cannot produce paying crops because of the presence of vast numbers of cutworms, locally known as "peelua" or "poko" worms, the young or larvæ of several species of moths belonging to the family Noctuidæ, which devour not only vegetable gardens but whole fields of forage plants.

One of the plant lice, the "green fly" (*Aphis* sp.) in the past season did much damage to the corn crop of the Kula District, on the Island of Maui. The yield of corn would have been large, but the attacks of the plant lice may result in driving many holders to give up their leases. It is not the small farmer alone who is the sufferer. The manager of one of the sugar plantations estimates a loss of $50,000 worth of cane on a single plantation through the destructive work of the cane borer, the larva of a beetle (*Sphenophorus obscurus*).

Mention should be made of the valuable work of Prof. A. Koebele, the Territorial entomologist, who has not only greatly benefitted these islands, but other countries as well, by the introduction of beneficial insects into infested regions. The lack of this natural check, (the insect enemies of injurious insects), greatly increases the percentage of loss through insect depredations. The introduction of such beneficial species will, when they became established, help to solve the problem of Hawaii's insect pests, but cannot be relied upon to exterminate the pests or render the use of insecticides unnecessary.

PRECAUTIONARY MEASURES.

Vegetable gardening in the vicinity of the larger towns is at present the only side of horticulture developed within the Territory. No large orchards or vineyards exist. Hawaiian agriculture is confined mainly to the production of field crops. The raising of fruits is for the most part limited to a small number of trees about the homes.

Generally speaking, the measures taken in combating the injurious insect pests of field crops must be precautionary, an effort to prevent their becoming established rather than attempting a remedy afterwards. But, when a pest is established, and its work is serious, the use of insecticides is in many cases feasible.

The "balance of nature" in these Islands is, at present, decidedly in favor of the insect pests. Thorough cultivation of crops, other than cane, has not been practiced; varieties of plants especially resistant to insect attacks have not been chosen; the proper time of planting has not always been taken into account; certain necessary elements, which the plants need for food, have been lacking in the soils, and, except in the raising of cane, have not been supplied by fertilizers. Insect pests have crept in upon us from abroad unobserved, leaving their enemies behind. There are no regular seasons of extreme cold or dryness, and, thus relieved of natural checks, the pests have multiplied rapidly. All these factors have turned the balance in favor of the pest. Every effort must be exerted to reverse the balance in favor of the plant. A good strong healthy plant will often show no serious effects from an attack by insects where a weak or poorly fed plant will be completely devoured. Clean cultivation; the burning of all rubbish about cultivated fields, which may harbor insect pests; planting at the time attacks are known to be less serious; and, using fertilizers to supply in abundance the necessary elements of plant food, will tend to make strong healthy plants which in many cases will withstand insect attacks and thus render the use of insecticides unnecessary.

GENERAL USE OF INSECTICIDES.

The practice of fighting insect pests by the use of insecticides has come into general use throughout the world. Both the entomologists and horticulturists of the U. S. Department of Agriculture at Washington and the various State experiment stations, have given much attention to this subject. The result is an im-

mense amount of scientific literature, much of which is within the reach of the ordinary reader. Detailed instructions covering the use of the more important insecticides, applying to the United States in general, are given in Farmers' Bulletin 127 of the U. S. Department of Agriculture, by C. L. Marlatt, First Assistant Entomologist, and the formulæ for the various insecticides given in the present bulletin are taken from this and other similar publications.[1]

BITING AND SUCKING INSECTS.

The injurious insects attacking the external parts of plants may be placed, in accordance with their manner of feeding, under two general heads:

Fig. 1. Leaf of grape-vine showing the work of a biting insect, the Japanese Beetle (*Adoretus umbrosus.*) (original.)

(1) Biting insects—those that injure vegetation by actually biting and eating the plant, (Fig. 1).

(2) Sucking insects—those that injure the plant by piercing the outer covering or epidermis, and, by means of tube-like mouth parts, sucking the sap or juice from the tissues of the plant, (Fig. 2, B.)

[1] This general bulletin may be obtained by applying to The Secretary of Agriculture, Washington, D. C.

The idea in the use of insecticides is to apply various poisons in such a way as to cause the death of the insects. In the case of *biting* insects the poison is an *internal* one, that is, the poison is applied to the food of the insect so as to be eaten with it, thereby causing its death. To kill the *sucking* insects the poison must be applied to the insects themselves, acting as an *external*

Fig. 2. Leaves of Corn. Leaf at left (B) showing the work of a sucking insect, the "Green Fly," (*Aphis* sp.) (original.)

irritant, since they do not chew the plant, and, therefore, will not take in the poison placed on the surface. The poisons used for sucking insects must kill by contact alone, and this class of insecticides is spoken of as the "contact" poisons. In no case must the remedy be worse than the disease, that is, it must not kill or seriously injure the plants while killing the pests.

PLATE I.

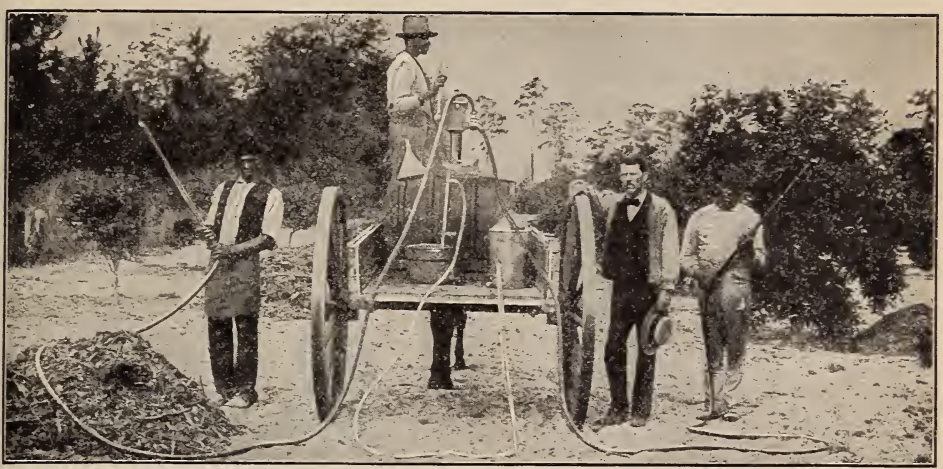

Fig. 1. A Hand-Spraying outfit in operation in a Florida orchard. (Yearbook U. S. Department of Agriculture. 1900.)

Fig. 2. A Hand-Spraying outfit in operation in a California lemon orchard. (Yearbook U. S. Department of Agriculture. 1900.)

Fig. 3. A Gasoline Sprayer at work in a California orchard. (Yearbook U. S. Department of Agriculture. 1900.)

The biting insects common in the Hawaiian Islands may be illustrated by the Japanese beetle, the cut-worms (peelua or poko worms), grasshoppers, the Olinda bug (*Armigus fulleri*), and others with biting mouth parts. Figure 1, illustrates the work of the biting insects.

The sucking insects are represented by the mealy bugs, scale insects, plant lice, and plant hoppers. In figure 2, B, the effect of the attack of a sucking insect is shown.

Fig. 3. A Bucket Outfit used in experiments at the Station.

Insects of both classes feeding on the external parts of the plant, offer a fairly easy problem of control. Those feeding on the internal parts of the plant, such as the cane borer and melon-fly, or on the roots of plants beneath the surface of the ground; various household pests; and insects living as parasites on domestic animals, present more difficult problems, and therefore demand special treatment in combating them.

SPRAYING APPARATUS.

The most common method of applying insecticides is by spraying. A liquid poison, to kill either by being eaten with the food or by contact with the insect itself is "sprayed" on the infested plants. Nearly every manufacturer of pumps has on the market apparatus made expressly for this purpose. These range all the way from a hand syringe (Fig. 5, A.) with a capacity of a few ounces, to steam or gasoline sprayers (Pl. I., Fig. 3) with a capacity of several barrels. The important parts of any spraying device are a pump to force the liquid out through a hose, and a nozzle (Fig. 5, C.) at the end to convert the liquid into a spray.

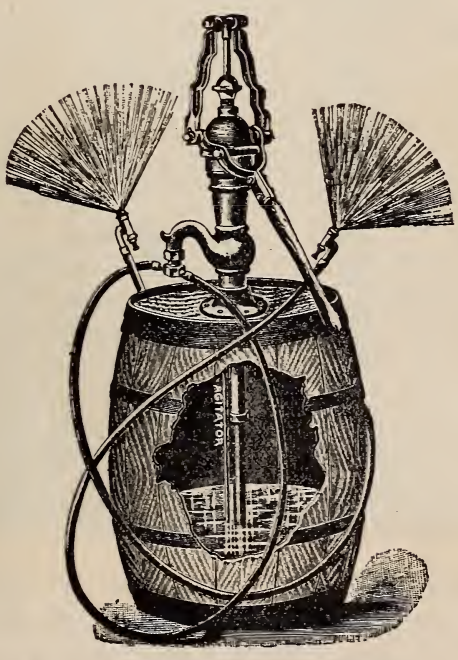

Fig. 4. Barrel Spray Pump.

Where the plants are of any height, trees for example, the nozzle must be brought in close proximity to the parts to be treated, since the liquid cannot be thrown any great distance. This is done by means of a handle of some light material, usually bamboo. (Note extension rods shown in illustrations Pl. I.)

SUCCESSFUL SPRAYING.

Successful spraying depends mainly on four things: (1), understanding the feeding habits of the insect, that is, whether

it is a bitting insect or a sucking insect; (2), the nature of the remedy to be applied; (3), the efficiency of the apparatus to cover the infested part of the plant; and, (4), the thoroughness with which the work is done. The frequency of showers in many localities in the Territory will make it necessary to spray more often than elsewhere.

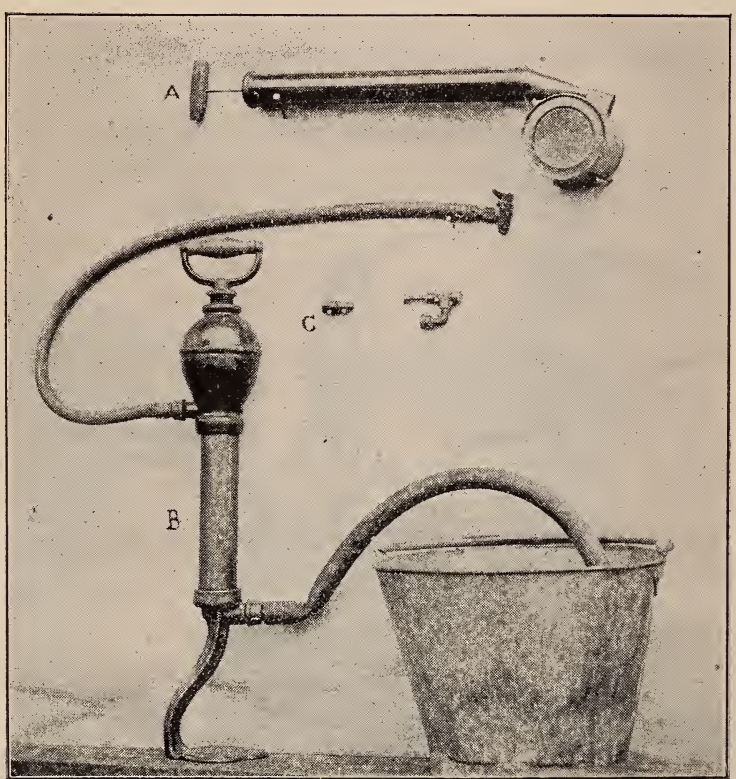

Fig. 5. Spraying apparatus in use at the Station, (original).[1]
A. A small hand sprayer. B. A strong force pump good for garden work and especially useful in making kerosene emulsion and other mixtures.
C. Two types of nozzles.

In cold countries the pests receive a natural check by the severe winters, and much of the spraying is done at the time when the plants are not in the leaf, since there is then no danger of damage to the foliage. However as insect pests find here in Hawaii a continuous supply of food, it will require a more persistent effort to keep them in check.

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1 The pumps shown in this bulletin, with the exception of those in Pl. I, are for sale in Honolulu.

INSECTICIDES.

SPRAYING MIXTURES FOR BITING INSECTS.

(Beetles, cut worms, grasshoppers, and others with biting mouth parts.)

Paris green:—

Paris green	pound	1
Lime	"	1
Water	gallons	100-250

To prepare this mixture slake the lime in 2 or 3 gallons of water and dilute to the desired strength. Mix the Paris green into a paste with a little water and stir into the lime mixture. The stronger mixtures are used for such vigorous foliage as that of the potato, the weaker mixtures for tender foliage, such as that of the peach. An average of 1 pound of Paris green to 150 gallons of water is a good strength for general purposes. The lime is added to combine with free arsenic which may be present and thus to remove or lessen the danger of scalding the foliage. The mixture should be strained before use to prevent lumps from clogging the spraying apparatus and should be kept constantly stirred or shaken to prevent settling. Apply by means of a pump, spraying the plants until they are evenly covered, but stopping before the mixture commences to drip from the leaves.

Paris green and Bordeaux mixture:—[1]

Paris green	pound	$\frac{1}{2}$
Bordeaux mixture	gallons	40-50

Bordeaux mixture is used to check the fungus diseases of plants. It is often used with success in combination with Paris green. Such a mixture has the advantage of not being readily

[1] Prof. B. T. Galloway, of the U. S. Department of Agriculture, gives the following directions for the preparation of Bordeaux mixture: "Into a 50-gallon barrel pour 30 gallons of water, and suspend in it six pounds of bluestone in coarse sacking. Slake 4 pounds of fresh lime in another vessel, adding water slowly to obtain a creamy liquid, free from grit. When the bluestone is dissolved add the lime milk slowly with water enough to fill the barrel, stirring constantly.....Use the Bordeaux mixture promptly, as it deteriorates on standing."

On account of its corrosive action the copper sulphate or bluestone should not be placed in iron or tin vessels. The mixture should be strained through coarse bagging to remove all coarse particles and thus avoid trouble and loss of time by the spraying machine becoming clogged.

washed away by showers, and plays a double part in destroying not only the insect pests, but the fungus diseases as well. This mixture is especially recommended for potatoes here and should be applied early, even before the effects of the cut worms and the fungus disease to which this crop is subject are to be seen.

Paris green has for years been the standard remedy for biting insects, such as cut worms, beetles, grasshoppers, etc., but on account of its high price and the difficulty of keeping it in suspension several other arsenical poisons have been recommended as substitutes for it under certain conditions, among these being arsenate of lead and arsenite of lime.

Arsenate of lead:—

Arsenate of soda	ounces	3
Acetate of lead (white sugar of lead)	"	7
Water	gallons	25

The arsenate of soda and acetate of lead should first be dissolved separately in a few quarts of warm water, using wooden vessels. When dissolved, mix together and dilute to the required proportions. When the two solutions are mixed a white precipitate of arsenate of lead is formed which is more easily kept suspended in water than any of the other arsenical poisons.

Arsenate of lead is now on the market, both as a dry powder and in paste form, ready for immediate use. It "may be used at any strength from 3 to 15 pounds to the 100 gallons of water without injury to the foliage, and in this respect is much safer on delicate plants than any other arsenical. Its use is advised where excessive strengths are desirable or with delicate plants where scalding is otherwise liable to result. With this insecticide there is an advantage in using the freshly prepared and wet mixture in that it gives a more filmy and adhering coating to foliage, the same fineness not being secured when it has been dried and repulverized."[1]

There is danger of this poison being mistaken for something harmless, because of its lack of color, and for this reason a dye is often added to prevent accident.

Soda Arsenite of lime:—

White arsenic	pound	1
Sal Soda crystals	"	4
Water	gallons	1

[1] Farmers' Bulletin 127, U. S. Department of Agriculture.

Boil the arsenic and sal soda in the water for twenty minutes, or until dissolved. Add enough water to make up for the loss by evaporation. This is the stock mixture and will keep indefinitely, but in all cases must be diluted greatly before using. For ordinary spraying operations add one pint of the stock mixture to 40 gallons of water, in which about three pounds of freshly slaked lime has been previously mixed. If used with the Bordeaux mixture the lime addition is to be omitted, using as before, one pint of the stock arsenical mixture for 40 gallons of the Bordeaux mixture. The arsenic unites with the lime to form arsenite of lime. The soda is used to hasten the process and to insure the combination of all the arsenic with the lime. The greatest care shoull be exercised in preparing the stock mixture, and afterwards in keeping it plainly labeled to prevent its being mistaken for some other substance. In actual practice the arsenite of lime has proved as effective as the older arsenical compounds. Its cost is very inconsiderable, which, with its known effectiveness, is its chief recommendation.

Pyrethrum:—

Pyrethrum or buhach, is the powder commonly used here against mosquitoes, by burning. "It acts on insects externally through their breathing pores, and is fatal to many forms both of biting and sucking insects. It is not poisonous to man or the higher animals, and hence would be used where poisons would be objectionable. Its chief value is against household pests, such as roaches, flies, and ants, and in greenhouses, conservatories, and small gardens, where the use of arsenical poisons would be inadvisable. . . It is used as a dry powder, pure or diluted with flour, in which form it may be puffed about rooms or over plants."[1]

Pyrethrum is also applied in water in the proportion of one ounce of the powder to two or three gallons of water.

Hellebore:—

White hellebore is an internal poison used against biting insects. Its use is limited because it soon loses its poisonous properties on exposure to the air, and is comparatively high in price. It is also less active than the arsenical poisons. It

[1] Farmers' Bulletin 127. U. S. Department of Agriculture.

is recommended for use in the treatment of plants the fruits of which are to be eaten shortly. The powder should be applied in the evening or morning, when the plants are wet with dew, or just after a shower. Applied with water use one ounce of hellebore to three gallons of water and apply with a spray pump.

DRY APPLICATION OF PARIS GREEN.

Paris green	pound	1
Flour or lime	"	10

Mix together thoroughly and apply with a powder gun or sack. Many forms of powder guns are on the market. A dusting sack can be made from any cloth material having an open mesh and the application is made by shaking the bag lightly over the plants.

The application of insecticides in dust form is strongly recommended by some writers. Over limited areas and on low-growing plants it can be done effectually, especially in the early morning or late evening when the dew is present to cause the poison to adhere better to the foliage. Marlatt says: "For application to vegetables which will ultimately be used for food, as the cabbage, 1 ounce of the poison should be mixed with six pounds of flour or ten of lime and dusted merely enough to show evenly over the surface. Arsenicals should not be applied to lettuce or other vegetables the free leafage of which is eaten."

Lime may replace the flour in the mixture, but it does not adhere to the plant so readily, and is less readily eaten by the insect.

In reply to an inquiry as to the importance of dust spraying as practiced in Missouri and adjacent States, Prof. J. C. Whitten, Horticulturist of the Missouri Experiment Station, writes as follows: "The dust spraying is assuming considerable importance with us where men have large orchards and have not the water or teams to spray with the great weight of water that is necessary in large orchards. It is particularly in favor in the rough fruit lands of the Ozarks where the steep hillsides and large areas make liquid spraying expensive and in some cases impossible.

In our judgment it is not generally so effective as liquid spraying where the latter can be thoroughly done but where one cannot spray with liquid it is way ahead of no spraying.

The following data in spraying for codling moth of the apple in our experimental orchard last year gives something of an idea of how it compares with liquid.

Check trees, not sprayed; fruit had 72 per cent affected with moth.

Dust sprayed trees had 36 per cent affected with moth.

Liquid sprayed trees had 16 per cent affected with moth.

In both cases Paris green was used to kill the moth, it being applied with air slaked lime as a dust and in the regulation way with water as a liquid spray."

At present Hawaii has no large orchards but should this line of agriculture become important, as it undoubtedly will in time, the results of the Missouri experiments will be well worth bearing in mind. Much of the land which might be used for fruit raising, especially fruits of the temperate zone, is found in the higher altitudes, where liquid spraying would be a difficult matter on any considerable scale because of the prevailing steep slopes.

POISONED BAITS.

The attacks of certain kinds of insects, such as the cut worms, are often most effectively checked by the use of various poisoned baits.

Arsenic and bran mash:—

White arsenic	pound	1
Sugar	"	1
Bran	"	6

Mix with just enough water to moisten the mass.

A dry mixture of bran and Paris green has been recommended for the cut worms. In either case place the mixture in rows in infested fields. Do this even before the pests put in an appearance. Frequent rains will make it necessary to repeat the operation. Care must be taken to keep domestic animals out of fields treated in this manner.

Another poisoned bait recommended by several authorities is freshly cut plants, such as sorghum, cabbage leaves, alfalfa, etc., dipped in a strong arsenical mixture and strewn about in infested places. The bait should be protected from drying by covering with boards or stones, and should be renewed as soon

as it becomes dry, or every 3 to 5 days. For insects such as cut worms, which work at night, the baits should be applied in the early evening so as to be as fresh as possible.

SPRAYING MIXTURES FOR SUCKING INSECTS.

(Scale insects, mealy bugs, plant lice, etc.)

This class of insect pests is widely distributed and occurs in large numbers throughout Hawaii. The most important insecticide for the sucking insects is kerosene emulsion.

Kerosene emulsion:—

The kerosene emulsion used in recent trials made by this Station was prepared in the following manner:

One-half pound of whale-oil soap was dissolved in one gallon of water while the water was boiling over a fire. While the solution of soap and water was still boiling hot it was removed a safe distance from the fire and two gallons of kerosene (coal oil) was added and the mixture thoroughly churned together with a force pump (Fig. 5, B) by pumping the mixture back into itself, using a nozzle throwing a direct stream. The emulsion was churned in this manner for about five minutes or until it had become creamy and all the free oil had disappeared.

This is the stock solution and in all cases must be diluted before it is applied to the insects on an infested plant. The emulsion thus made kept well for several weeks. If the oil separates from the mixture it will rise to the top and should be skimmed off before the emulsion is applied. Any hard soap shaved fine may be used in place of the whale-oil soap.

The emulsion should not be diluted until wanted for use. The amount of water added to dilute the stock solution depends on the pest to be destroyed; that is, whether it is a "hard" or "soft" bodied insect. The soft-bodied insects are well illustrated by the mealy bugs and the plant lice. The bodies of the scale insects are covered by a hard waxy excretion which resists the action of the emulsion or other insecticides. A strength of 1 part of the emulsion to 20 parts of water was sufficient to kill the aphis on rose bushes and cucumber vines; 1 part of the emulsion was added to 15 parts of water and used with success against the mealy bug on citrus trees. The powdery or "mealy" excretion of the wax-like substance

with which this insect is covered necessitated using the stronger solution (15 to 1, instead of 20 to 1.) In some cases a second spraying was necessary to kill all of the mealy bugs, probably because the emulsion did not injure the eggs. A second spraying about ten days after the first application, if done thoroughly, will entirely clear the plants of the mealy bug. In the case of the "purple" scale of the orange, and the "rose" scale, a strength of 1 part of emulsion to only 10 parts of water was found necessary to kill the insects.

Fig. 6. Mealy Bug (*Eriococcus?*) on the Alligator Pear, (original)

Since the emulsion kills only by actual contact with the insect, it is absolutely necessary that each insect be covered by the emulsion in order to destroy all.

A small quantity of the emulsion can be made from the following formula and applied to plants where the number to be treated is small, as in a dooryard, by such a sprayer as shown in Figure 7.

Cook's hard soap emulsion:—[1]

"Dissolve one-fourth pound of hard soap—or whale-oil soap—in two quarts of water, add one pint of kerosene oil, and pump

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Lodeman. "The Spraying of Plants." p. 154.

the mixture back into itself while hot. This always emulsifies at once, and is permanent with hard or soft water. This is diluted with twice its bulk of water before use." This small amount can be agitated or emulsified with an egg-beater, if a force pump or syringe is not available.

Kerosene and water are often applied by means of a spraying apparatus which mixes them automatically in the desired pro-

Fig. 7. Compressed Air Hand Sprayer.
The glass jar resists the action of corrosive mixtures.

portions, thus doing away with the necessity of an emulsifying medium such as the soap. There are several such pumps on the market.

The following caution in regard to the use of kerosene emulsion or other oily washes is taken from Farmers' Bulletin 127: "In the use of kerosene washes, and, in fact, of all oily washes on plants, the application should be just sufficient to wet the plant, without allowing the liquid to run down the trunk and collect about the crown. Usually around the crown, in the case of young trees at least, there is a cavity formed by the

swaying of the plants in the wind, and accumulation of the insecticide at this point, unless precautions be taken, may result in the death or injury of the plant. Under these conditions it may be advisable to mound up the trees before spraying and firmly pack the earth about the base. Care should be taken in refilling the tank that no free oil is allowed to accumulate gradually in the residue left at the bottom, when spraying with emulsions or oil-water mixtures."

Whale oil soap:—

Whale on soap	pound	½
Water	gallon	1

Dissolve the soap in hot water and apply while still warm with a spray pump. A solution of the above strength will be effective against plant lice and other soft bodied insects. For scale insects a stronger solution (2 pounds of soap to 1 gallon of water) is required. There is danger of a strong solution injuring the foliage and since here in Hawaii the plants are always in leaf such solution should be used with caution. "With large trees, or badly infested trees, preliminary to treatment it is desirable with this as well as other applications to prune them back very rigorously. This results in an economy of spray and makes much more thorough and effective work possible."

Resin wash:—

Resin	pounds	5
Caustic soda (crude 78 per cent)	"	1
Fish oil (whale oil soap)	"	½
Water	gallons	20

Place the resin and soda, "with the oil, in a kettle with water to cover them to a depth of three or four inches. Boil about two hours, making occasional additions of water, or until the compound resembles very strong, black coffee. Dilute to one-third the final bulk with hot water, or with cold water added slowly over the fire, making a stock mixture, to be diluted to the full amount as used. When sprayed the mixture should be perfectly fluid, without sediment, and should any appear in the stock mixture reheating should be resorted to, and in fact the wash is preferrably applied hot."[1]

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[1] Farmers' Bulletin 127, U. S. Department of Agriculture.

This wash is generally used on trees in a dormant condition, that is, trees which have shed their leaves and are undergoing a period of rest. The lack here in these Islands of a definite period of rest on the part of the trees will necessarily restrict the use of this wash.

GAS TREATMENT.

Treatment with certain gases has been found to be very effective in destroying insect pests. In applying this method it is necessary that the plant be placed in an air-tight room (as for nursery stock) or covered by a tent. Carbon bisulphide and hydrocyanic acid gas are the two gases most frequently used.

Carbon bisulphide:—[1]

Ants may be killed by first making holes in the nest and pouring into each about an ounce of carbon bisulphide and closing the holes with earth.

Plant lice on small plants may be killed by placing an ounce or more of the carbon bisulphide in a dish under the plant and covering the plant with an air-tight box.

This substance is used with great success against insect pests infesting stored grain. It is poured on the top of the grain in bins, or a small room, more or less air-tight, at the rate of 1 pound to 1 ton of grain or 10 cubic feet. The gas is heavier than the air, and for this reason will sink into the mass. Marlatt says. "The bisulphide may be more freely employed with milling grain than that intended for seeding, since when used excessively it may injure the germ."

Carbon bisulphide is expensive when purchased from retail druggists by the pound. It can be purchased from wholesale houses in 50 pound lots or more for about 10 cents per pound, the buyer paying the freight charges.

Attention should be "called to the danger from fire in the presence of carbon bisulphide vapor in the air, but special reference should be made to it in connection with the treatment of buildings. It is customary to mention the danger of bringing a lighted cigar or any such thing into the presence of the fumes. The application should always be made in daylight

[1] Hinds "Carbon Bisulphide as an Insecticide." Farmers' Bulletin 145 U. S. Department of Agriculture.

as no artificial light of any kind is allowable."[1] The same care should be exercised in the handling and storing of carbon bisulphide as is customary with other high explosives.

Hydrocyanic acid gas:—

This gas, used extensively in certain sections of the country for scale insects, is generated by adding potassium cyanid to a mixture of water and sulphuric acid. The proportions depend on the space the gas is to occupy. This is a violent poison, and since the fruit industry is not at present developed to any extent here, further information is not demanded.

ANNOUNCEMENTS.

This station has procured an extensive supply of the different insecticide substances, and will give them a thorough test, along with the various kinds of spraying apparatus, to determine which are best suited to Hawaiian conditions.

Persons interested in the subject can secure all available information by addressing the station.

Samples of Paris green sent to the station will be tested for purity as carefully as the limited means will allow and reported upon.

Persons writing to the station for help in combating pests should send specimens of the injurious insects, with parts of each plant, showing what damage they are doing, and attach to each specimen the name of the sender and locality. Whenever possible, the locality will be visited by the entomologist and personal advice given.

Bulletins of the station will be sent free to the residents of the Territory on request.

All communications should be addressed to Jared G. Smith, Hawaii Experiment Station, Honolulu, Hawaii.

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1 Farmers' Bulletin 145. U. S. Department of Agriculture.